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**UNMANNED SURFACE VEHICLES (USVs): A JFMCC OPERATIONAL
PROTECTION CAPABILITY**

by

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**A paper submitted to the Faculty of the Naval War College in partial satisfaction of the
requirements of the Department of Joint Military Operations.**

**The contents of this paper reflect my own personal views and are not necessarily
endorsed by the Naval War College or the Department of the Navy.**

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Abstract

Achieving and maintaining operational protection has created three significant challenges for the JFMCC within his area of operations (AO). First, a larger AO requires a greater footprint of forces in support of the theater. Second, the protection of this theater necessitates a more durable, permanent level of security, lasting months or even years. Areas of responsibility (AORs), such as Pacific Command (PACOM) and Central Command (CENTCOM), face Anti-Access/Area Denial (A2/AD) threats that require a continuous maritime presence. Lastly, the maritime domain encompasses a wide variety of new threats in a more challenging asymmetric environment. These challenges require a greater, sustainable maritime force in order to maintain the balance of global security. Unmanned Surface Vehicles (USVs) represent a significant operational protection capability to the JFMCC for effectively accomplishing the core elements of Anti Submarine Warfare (ASW), Mine Countermeasures (MCM) and coastal surveillance/defense in support of 21st century maritime security operations (MSO) mission.

INTRODUCTION

The Joint Force Maritime Component Commander (JFMCC), as the Navy's component commander responsible to the Joint Force Commander (JFC), faces a significant challenge within the maritime domain in achieving the required flexibility and footprint of maritime forces to meet the core elements of operational protection¹ in support of the maritime security mission. Disputed and contested waterways, such as the Straits of Malacca and the Straits of Hormuz, are becoming more prevalent around the world and now have greater operational and strategic impacts based on the globalization of maritime trade.

Achieving and maintaining operational protection has created three significant challenges for the JFMCC within his area of operations (AO). First, a larger AO requires a greater footprint of forces in support of the theater. Second, the protection of this theater necessitates a more durable, permanent level of security, lasting months or even years. Areas of responsibility (AORs), such as Pacific Command (PACOM) and Central Command (CENTCOM), also will face Anti-Access/Area Denial (A2/AD) threats that may require a continuous maritime presence. Lastly, the maritime domain encompasses a wide variety of new threats in a more challenging asymmetric environment. These challenges require a greater, sustainable maritime force in order to maintain the balance of global security.

Unmanned Surface Vehicles (USVs) represent a significant operational protection capability to the JFMCC for effectively accomplishing the core elements of Anti Submarine Warfare (ASW), Mine Countermeasures (MCM) and coastal surveillance/defense in support of the 21st century maritime security mission.

THE MARITIME DOMAIN

The world's economy is tightly interconnected, with over 90 percent of the world's trade and nearly 67 percent of the world's petroleum being transported by sea.² The maritime domain, consisting of the world's oceans, seas, coastal areas and littorals supports globalization by linking every country on earth that relies on sea based transit. This global system expansion has allowed many nations to prosper, but has also created a shortage of resources and caused increased regional instability.

Competition for these scarce resources has encouraged nations to exert wider claims of sovereignty over adjacent oceans, waterways and littoral regions, potentially escalating into territorial conflicts. Acts such as terrorism, piracy, drug trafficking and weapons proliferation threaten the balance of global stability and security. Today, the United States must apply seapower around the world in order to protect U.S. vital interests at home and abroad. Excessive territorial water (TTW) claims by Iran (i.e., the "black line") are just one example of the JFC's concerns when positioning maritime forces within an AO in order to maintain protection and security. The Chief of Naval Operations (CNO) has stated that the concept of applying seapower is part of the overall strategy that "preventing wars is as important as winning wars."³

NATIONAL STRATEGY

Our strategy to meet these challenges in the maritime domain is outlined in the National Military Strategy (NMS). The NMS reveals the need for a modular, adaptive, general purpose force that can be employed in the full range of military operations. First, these forces must have the capability to surge on short notice, deploy agile Command and Control (C2) systems and be increasingly interoperable with other services. Second, these

forces must contain a greater expeditionary capability and will require a smaller logistical footprint, reducing significant fuel and energy demands. Finally, these forces must ensure access, freedom of maneuver, and the ability to project power globally throughout all domains.⁴

SUPPORTING ARGUMENTS

In the January 2012 Joint Operational Access Concept (JOAC), the Chairman of the Joint Chiefs of Staff (CJCS) outlined his vision for how joint forces would operate in response to emerging security challenges, including A2/AD. The JOAC describes how operational access⁵ is critical in order to counter A2/AD, which operates on the principle of attrition. Operational access does not exist for its own sake, but rather serves broader strategic goals.

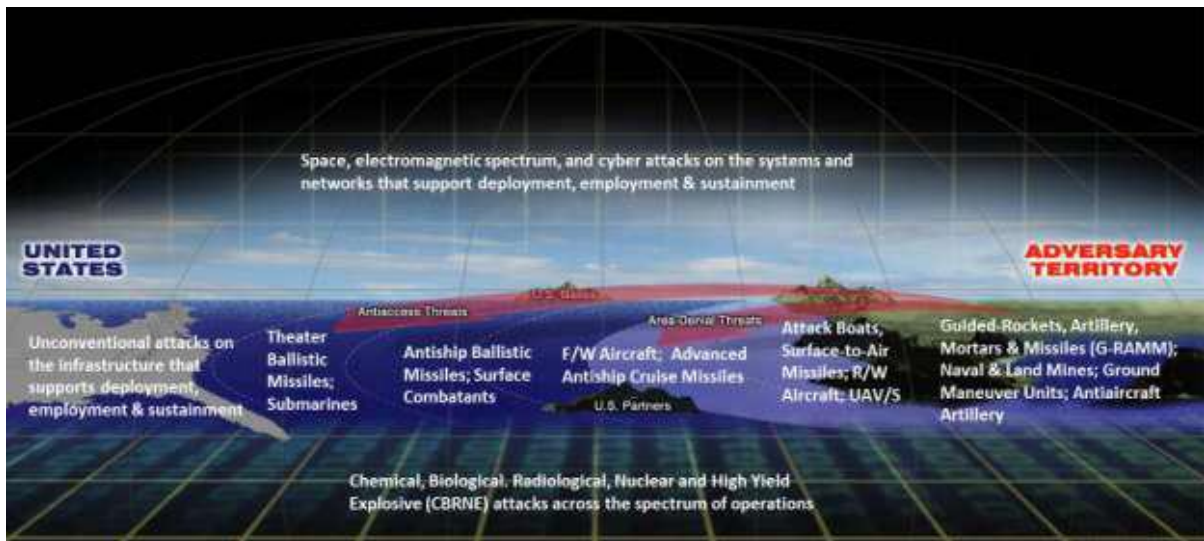


Figure 1 – A2/AD capabilities as part of a layered, integrated defense

Operational protection, in a Joint Operational Access environment, involves a combination of both active and passive measures to defeat enemy attack.⁶ Maintaining operational access necessitates achieving and maintaining operational protection. The overall goal is to minimize exposure of the force during its advance toward an objective area,

where many elements of the force are most vulnerable. Dispersion, multiple lines of operations, speed and maneuver that reroutes around threats, deception and disruption of enemy intelligence collection are methods to counter a threat to the force.⁷

The Maritime Strategic Concept, as incorporated into *A Cooperative Strategy for 21st Century Seapower*, outlines in detail how the Navy's force will be shaped to meet our maritime security mission:





The expeditionary character and versatility of maritime forces provide the U.S. the asymmetric advantage of enlarging or contracting its military footprint in areas where access is denied or limited. The sea is a vast maneuver space, where the presence of maritime forces can be adjusted as conditions dictate to enable flexible approaches to escalation, de-escalation and deterrence of conflicts. The speed, flexibility, agility and scalability of maritime forces provide joint or combined force commanders a range of options for responding to crises.⁸

“We can’t run at that rate.”⁹ This comment in a Navy Times article was made in April 2012 by the Chief of Naval Operations in regards to the Fleet’s pace of operations. The operational tempo (OPTEMPO) of our Fleet is surging and the CNO has deemed it unsustainable over the next five years as the high demand continues for ships and submarines. The sober reality is that the U.S. Navy’s force structure does not have the capability and capacity to fully support the maritime security mission due to multiple other mission requirements and a finite amount of maritime resources available in theater to each JFMCC.

Long-term security sustainment has strained our limited high demand, low density multi-mission surface combatants that are tasked to support other missions (e.g. Ballistic Missile Defense, ASW, MCM, etc). As our oceans and littorals become more volatile, the JFMCC must decide what level of risk is acceptable when employing warships into these contested areas. Meeting the 21st century operational protection requirement will require

employing alternative options, such as unmanned surface vehicles (USVs), in order to cover a greater area within an AO with limited assets.

The concept of unmanned surface vehicles has been around since WWII, initially developed and employed for purposes such as minesweeping and battle damage assessment (BDA). Within the last five years, the USV concept has begun to emerge as an effective operational capability to support the JFC/JFMCC objectives. There are seven high-priority USV missions that can be accomplished with three standard vehicle classes and one non-standard vehicle class.¹⁰ These USV missions can support the JFMCC in effectively achieving and sustaining operational protection by complementing the elements of ASW, MCM and coastal surveillance/defense and maintaining security and stability within the AOR.

							
USV MP Priority	Joint Capability Area (JCA)	Seapower Pillar	USV Mission	X-Class (small)	Harbor Class (7M)	Snorkeler Class (7M SS)	Fleet Class (11M)
1	Battle Space Awareness (BSA) / Access/ Littoral Control	Sea Shield	Mine Countermeasures (MCM)		MCM Delivery, Search / Neutralization	MCM Search, Towed, Delivery, Neutralization	MCM Sweep, Delivery, Neutralization
2	BSA / Access/ Littoral Control	Sea Shield	Anti-Submarine Warfare (ASW)			Maritime Shield	Protected Passage and Maritime Shield
3	BSA, HLD, Non-Trad Ops, 7 Others	FORCenet	Maritime Security		ISR/ Gun Payloads		7M Payloads
4	BSA / Access/ Littoral Control	Sea Shield	Surface Warfare (SUW)		SUW, Gun	SUW (Torpedo), Option	SUW, Gun & Torpedo
5	BSA / Access/ Littoral Control/ Non-Trad Ops	Sea Strike	Special Operation Forces (SOF) Support	SOF Support	SOF Support		Other Delivery Missions (SOF)
6	BSA, C&C, Net Ops, IO, Non-Trad Ops, Access, Littoral Control	Sea Strike	Electronic Warfare		Other IO	High Power EW	High Power EW
7	BSA, Stability, Non-Trad Ops, Littoral Control	Sea Shield	Maritime Interdiction Operations (MIO) Support	MIO USV for 11M L&R	ISR/ Gun Payloads		

Primary Missions supported by			
X-Class	Harbor Class	Snorkeler Class	Fleet Class
Secondary Missions of each class that are possible			

Figure 2 - Four USV Classes

ASW is a complex problem that requires dedicated resources for an extended duration to search, track/localize and prosecute the adversary in order to complete the mission. As the nickname “Awfully Slow Warfare” refers, ASW operations are a detailed, systematic combination of both art and science. Diesel submarines have been exported by several countries around the world or are indigenously built at home. Affordable technology has allowed smaller nations the ability to use submarines to strengthen their navies as part of regional defense. Despite a few environmental restrictions, in particular water depth, submarines can operate in nearly any shallow water environment. One diesel submarine empowers an adversary with the capability to conduct A2/AD, effectively degrading or disrupting our access to any strait, chokepoint or other littoral region. For example, in the last few months, recent political tensions and economic policies in the Straits of Hormuz have added credibility to a potential A2/AD threat.

Current ASW techniques are effective, but employing USVs provides several advantages to complement conventional forces conducting future ASW operations. First, most of the threat submarines which the U. S. Navy will face in the foreseeable future will be conventional (e.g., diesel-electric) and designed for local or regional coastal defense. Second, these adversary submarines will operate with greater ease in shallower waters and be able to submerge near their homeports and outside anyone’s reach due to TTW restrictions. Finally, the increased numbers of submarines that will be deployed by our adversaries require enhancing the efforts of existing ASW forces.¹¹

Littoral ASW operates in three major categories: (1) Hold at Risk – monitoring submarines that exit a port or transit a chokepoint. (2) Maritime Shield – clearing and maintaining a large Carrier Strike Group (CSG) or Amphibious Ready Group (ARG)

operating area free of threat submarines and (3) Protected Passage – clearing and maintaining a route for an ESG from one operating area to another free of threat submarines.¹²

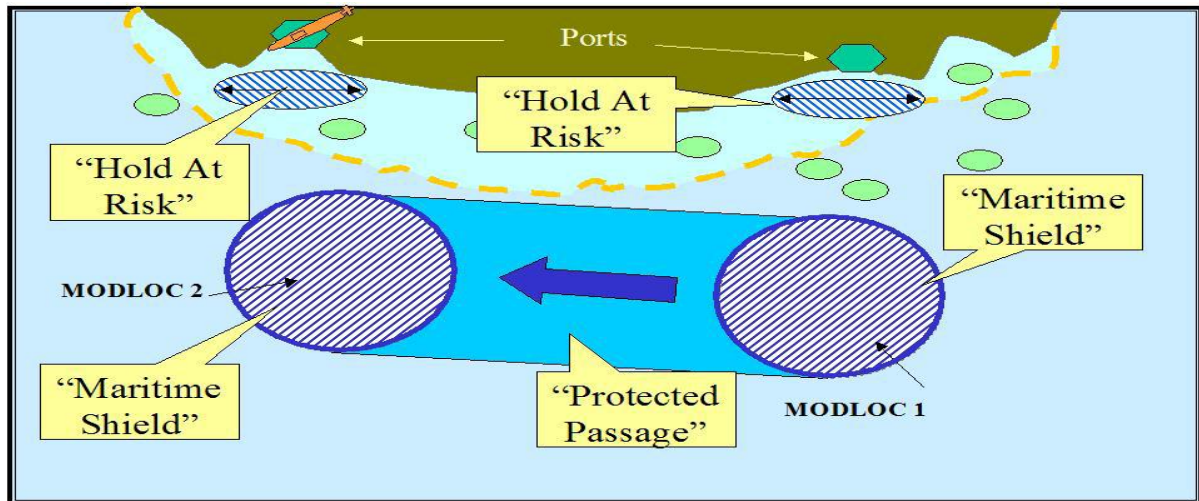


Figure 3 - Task Force ASW Littoral Operations

In addition to increasing the size of the JFMCC's force, USVs expand the operating area in which assets are allocated in support of ASW operations, due to their capability of performing the ASW mission at some level of autonomy. Operating in a semi or fully autonomous role provides a layer of ASW defense-in-depth for the CSG, ARG or other high value unit (HVV), while freeing the multi-mission surface combatants to conduct other national tasking. Subsequently, there is a reduction in risk to those warships that would otherwise have been conducting the ASW mission themselves.

USVs are also able to serve as third party sensors or sources, extending detection ranges while utilizing one ship as the C2 platform for multiple vehicles, providing the decision-making capabilities needed while remaining outside of the torpedo danger area (TDA). In addition to using third-party sensors and cueing assets, platform sonars are available as sources for multi-static prosecution. The USV may also be tasked to plant its own organic sonobouy sensor field, increasing reaction time and space if a submarine is detected.¹³

Establishing stand-off submarine surveillance barriers can be created without escalating the level of conflict or placing additional risks on manned ships. This capability enhances the ability of the JFMCC to achieve operational access and maintain operational protection. A submarine free corridor created by USVs instead of a manned platform can also greatly enhance the ability of the JFMCC to reposition manned forces at will. Searching specific operating areas (OPAREAS) in which friendly forces will operate or conduct freedom of navigation transit allows USVs to act as a credible deterrent to an adversary submarine threat.

While ASW operations are time and resource intensive to the JFMCC, MCM operations pose similar challenges to operational access and protection. Mining a port, strait or chokepoint is the easiest, quickest and cheapest way to degrade or disrupt operational access. Even a mine threat will significantly impact the ability to maintain operational protection and accomplish the mission. A mine danger area could jeopardize a mission, along with the undue risk to personnel and ships in the area conducting operations.

MCM mission requirements are driven by the Fleet's need to rapidly establish large, safe operating areas, transit routes (i.e., Q-routes) and transit lanes. These areas typically have long sea lines of communication (SLOCs), offshore Fleet Operating Areas (FOAs), Amphibious Operating Areas (AOAs) and Littoral Penetration Areas (LPAs).¹⁴ The JFMCC must balance the time and asset requirements needed to neutralize the routes prior to the ship's arrival in order to gain access to the operating area.



Figure 4 – MCM Operating Area

Current MCM force capabilities are reaching the end of their service life and the Navy's replacement littoral platform, the Littoral Combat Ship (LCS), will be tasked with undertaking the burden of meeting our required MCM capability in order to maintain operational access around the globe. Coalition partners have continued to provide MCM platforms to assist in theater, but our shift to operating in the littorals requires greater organic capability for mine neutralization operations within that environment.

USVs generate significant mine hunting and sweeping coverage at lower costs by multiplying the effectiveness of supporting or dedicated platforms. Force capability is expanded by USVs providing an organic MCM capability on other platforms, such as DDGs, which are not traditionally assigned or equipped for mine neutralizing operations. The introduction of USV-based MCM systems will provide the JFMCC the ability to conduct organic mine countermeasure operations at safe standoff ranges and enable joint operations to be conducted ahead of the arrival force. These MCM operations will open transit lanes, clear operating areas and enable protection for naval, joint and coalition forces, again while minimizing the risk to manned platforms.

In addition to expanding the force capability in an AO, the use of multiple USVs for MCM operations will reduce the time required to neutralize an area in order to provide safe routes through potentially mined waters. These vehicles can gather as much information as possible, as early as possible, in order to minimize the magnitude of follow-on MCM operations required. Through the application of USV-based MCM systems, the timeline for gaining operational access to a contested littoral region can be accelerated, giving a broader range of options to the JFMCC.¹⁵

Knowledge of the operational environment along with intelligence on the adversary's capabilities will focus efforts on possible mine threats and likely mine threat areas, allowing for these mined areas to be avoided entirely. An effective Intelligence, Surveillance and Reconnaissance (ISR) program in support of operational protection may help to distinguish between various types of adversary threats and provide cueing and intentions, providing for a more appropriately focused response from U.S. forces.

The development of a completely independent, fully autonomous, long-term USV MCM capability with large area search, autonomous target identification (ID), and fully autonomous neutralization is a near term reality.¹⁶ The current MCM capabilities that USVs provide effectively complement existing MCM forces. Once the fully autonomous USV MCM capability is available, the JFMCC will be able to achieve operational access and maintain operational protection in any of the world's littoral regions, regardless of the location of the mine threat.

ASW and MCM missions, while challenging and extensive, are normally limited in duration. Coastal surveillance/defense, however, may require a permanent force footprint and can last indefinitely. This mission poses one of the greatest threats to sustainment of operational protection. Whether it is protection of a port or maintaining the security of SLOCs, coastal surveillance/defense is essential to protecting both our global economic interests as well as freedom of action in support of mission objectives. Piracy, fast attack craft/fast inshore attack craft (FAC/FIAC), mines and submarines will threaten the JFMCC's area of operations. The employment of unmanned surface vehicles supports in providing a long range, standoff capability to counter these threats and maintain coastal security. The

emergence of newly contested waterways requires a larger security footprint to maintain our desired level of operational access and protection.

U.S. interests are deeply intertwined to the security and stability of alliances, partnerships, and multi-national coalitions. The disposition, strength, and readiness of our Joint Force form a global defense posture that provides unsurpassed capabilities allowing strengthening security across all regions.¹⁷ Our strategic goal to pursue security cooperation helps to strengthen the defense capabilities of our allies and regional partners. This collective regional security has allowed the U.S. to preserve operational access and protection to the regions, bases, ports, and airfields needed to safeguard our economic and security interests worldwide. Theater security cooperation (TSC) has aided in achieving regional security and stability for the geographic combatant commanders (CCDRs) while burden sharing the resources needed to maintain a durable level of security and protection.

Despite these initiatives, some of our regional partners will be unable to continue the level of investment in military funding needed to support regional defense and security. The majority burden of meeting global security requirements will fall to the United States. Initiatives such as moving four DDGs to Rota, Spain or LCS platforms to Singapore will help alleviate some of the force sustainability concerns. As our own force becomes streamlined to meet the needs of the 21st century, it will not be sufficient to meet all our security requirements.

USVs have proven effective and will continue to evolve to meet the requirements of an adaptive force. With a multi-function capability and the ability to operate from a variety of platforms, USVs can perform both data collection and security missions in high risk areas or where hazards to navigation preclude ships to operate. USVs are not only essential for the

traditional purpose of intelligence collection and threat deterrence, but also as a precursor and enabler for essentially all other missions in the region.

These vehicles can be launched from a surface ship or shore facility from a safe standoff distance, transit to the area of interest, and return with or transmit ISR data collected, extending the reach of their launch platforms by more than 150 nm. Once on station for patrols, the USV can reach speeds up to 40 knots and have an on station endurance time of 24-48 hours, depending on class type. This level of sustainability and versatility is available with the different levels of autonomy. The vehicle can autonomously reposition itself as necessary, both to collect additional information and to avoid or intercept threats, providing an indefinite presence in the operating area. In most cases, the vehicle will be in real-time or near real-time communications with the C2 platform and can provide information as desired, as well as receive updated instructions from the control platform.

OPERATIONAL CHALLENGES

Despite the capabilities of USVs to complement manned platforms, there are several inherent vulnerabilities that could limit their effectiveness in supporting operational protection. First, these vehicles have limited, combat tested C2 and network capabilities that create other vulnerability issues to the exchange of data and communications to the control ship. Second, with the ability to employ armed mission packages, legal considerations such as Rules of Engagement (ROE), Law of Armed Conflict (LOAC) and compliance with international maritime law have not been completely resolved. Finally these vehicles, the size of a 7m or 11m Rigid Hull Inflatable Boat (RHIB), are more susceptible to environmental factors and weather which impact their endurance, level of autonomy and overall mission effectiveness.

C2 and network security breakdowns will guarantee the failure of an operation or mission. Real time data must be exchanged between platforms and interoperability between services and other agencies must be available in order for USVs to be effective. Jamming or cyber attack vulnerabilities, limited bandwidth for data exchange and network security issues have not been fully resolved. Safeguards to C2 degradations and network security reliability and further T&E must occur to the level required for shipboard C4I systems. USVs must not only complement existing forces, but have the capability to replace ships in high risk locations where other platforms cannot operate.

While USVs have the capability to operate in manual or semi-autonomous mode, the capability for fully autonomous operations has limited operational testing in support of ASW or MCM operations. A human interface as the central C2 element and a dedicated communications path for intelligence and data exchange is still required. Overall, operational testing of USVs in theater has not been fully developed to the level of other unmanned programs. In FY 2011, USVs received only two percent of the budget allocated to the UAV program.¹⁸ This funding included research and development (R&D) as well as testing and evaluation (T&E). Until the program receives the level of attention and fiscal resources to ensure our ability to operate as needed, the role of USVs in the joint theater and ability to support operational protection will remain limited.

Due to the limited combat employment of USVs, many legal experts are still debating ROE/LOAC issues in regards to their use in a maritime environment. In March 2012, the Naval War College hosted an Unmanned Maritime Systems Legal Workshop to continue the discussion of these issues. According to the workshop, unmanned maritime systems are vessels designed to operate on-or-underwater without a human operator onboard, similar to

drone aircraft.¹⁹ But according to legal experts, there are questions about how they should be classified (i.e. vessel, warship or torpedo) within maritime and armed conflict laws.²⁰

This question of classification raised four main issues on unmanned maritime vessels. These issues include the status of various types of unmanned vessels, maritime “rules of the road”, maritime zone and law of armed conflict issues. Classification of what type of object these unmanned systems are considered is important if USVs must abide by the same international laws as other ships.²¹ Freedom of Navigation (FON) operations, rules of the road compliance and basic navigation requirements based on the United Nations Convention on the Law of the Sea (UNCLOS) must be considered. The use of unmanned surface vehicles will have to be recognized by the international community to ensure legality during employment.

The MCM, ASW, and coastal defense missions may require carrying and possibly employing weapons. Once a USV is armed for a particular mission, these ROE and LOAC are immediately in effect. There are technical and operational problems associated with weapon release, either autonomously or man-in-loop using Over the Horizon Targeting (OTH-T), which further compounds the legality of employing a USV as a weapon. Legal and procedural guidelines, such as friendly-fire prevention procedures, ROE, law of the sea and International Regulations for Preventing Collisions at Sea (COLREGs), must be taken into account, together with technical development and training, in realizing these capabilities.²²

The classification of USVs is also critical when attempting to maintain a de-escalatory posture within a region. A U.S. warship conducting security patrol operations in the Northern Arabian Gulf along Iran’s TTWs will be viewed as escalatory in nature due to the type of ship. A warship maintains an inherent right to unit and collective self defense

and sovereignty that may not apply to USVs. The mere presence of an armed USV may be viewed as a provocative act and treated as hostile intent or hostile act. If this vehicle is operating autonomously without a human decision interface in the equation, the question remains whether these platforms are legally used in maritime warfare and still comply with international law. Further discussions and decisions will be required as to the future roles and missions of USVs. Preliminary findings indicate that until these legal issues are resolved, it will be difficult to legitimize the program as an effective option to meet our increasing operational needs.²³

Ships are highly susceptible to environmental elements of weather and sea state. These factors can also degrade capabilities in radar and communication systems and impact mission effectiveness. Primary technical challenges for weapon release from USVs include the ability to reliably target and achieve proper tracking in all sea states where the system is likely to be employed. High sea states may pose problems with USV station keeping, weapons employment, data collection/exchange and system deployment.

REBUTTAL

Despite these vulnerabilities, USVs will prove effective to our CCDRs and JFMCCs and will aid in expanding our maritime reach to all corners of the globe. Within the next two years, the USV program will focus its research and development to resolve these technology and other interoperability issues. By FY15, procurement of USVs will increase tenfold from FY11,²⁴ allowing every theater to have these vehicles and operate them in real world operational environments. Staffs and shipboard operators will provide valuable feedback and issues on USV operations, further improving the testing and evaluation process. Lessons

learned and guidance on the legal employment from other unmanned program (e.g. UAVs) should be applied to USVs while working with regional partners on the international laws.

RECOMMENDATIONS/WAY AHEAD

USVs will have the near term capability within the next couple of years to effectively integrate in our force structure to meet our operational protection requirements. The key for USVs to meet the challenges and requirements in the future involves solutions for the complexities of vehicle design, configuration and operation. One of the strengths of USVs is the wide variety of USV missions that can be conducted in a limited number of vehicle classes. Given the multi-mission nature of modern surface ship tasking, the evolving USV development process should include the use of common components, hardware, software and interfaces. This system commonality must be established for system C2, interoperability and modularity by means of using Commercial off the Shelf (COTS) equipment and FORCENet-based architecture will ensure USV interoperability with other systems.²⁵

By developing and following up-to-date standard interfaces and USV payload standards, the need for custom interfaces and payloads could be mitigated or eliminated. Standardization between modules for a given vehicle class will ease payload module transfer between vehicles or vehicle transfer between host platforms. Interoperability issues are being resolved to allow transfer of vehicle control from one operator to another. Also control of multiple types of vehicles will be achieved from a single control station, allowing for interservice as well as intraservice mission handover during operations.

Experimentation with systems should be expanded to provide risk reduction for technology and operations. It is essential to involve operators throughout the development process to expand and refine employment concepts. Additional legal review of autonomous

USV operations and vehicle weaponization must occur and further define its mission role. Continued introduction of functional USVs into the fleet is critical. Vehicles such as the multi-purpose Spartan-Scout USV and the Sea Fox ISR USV must be included in the operation training cycle of ships and strike groups. These capabilities need to be provided to the Fleet for experimentation and feedback.

The USV program has been characterized as a “crawl-walk-run” capability. In order for these systems to be accepted and integrated into Fleet operations will require our training and tactics, techniques and procedures (TTPs) to evolve with the program. Ships and strike groups that are training for the AOR that they are deploying to must be integrated with the employment of USVs during certification and deployment workups. In theater, the JFMCC staff must understand the capabilities and limitations of USVs in order to effectively employ them to complement their forces. Fleet feedback and operational lessons learned will generate further T&E and be addressed in Fleet wide operational orders (OPORDs), operational tasking (OPTASKs) and individual shipboard Battle Orders.

CONCLUSION

The CNO has already expressed concerns about the Fleet’s future sustainability. As more ships reach the end of their service life or are decommissioned due to excessive maintenance costs, we will lack the sufficient force needed to meet the current security demands. The pursuit of refining USV operability is more vital than ever and will require a renewed sense of the attention as we strive to meet the challenges of our Fleet operations. USVs are not the sole answer to resolving our force sustainability issues, however, the next five years are critical to determine our way ahead to maintain global operational access and

protection. These vehicles' roles will continue to expand and complement our high demand Fleet platforms.

NOTES

¹ Vego, Milan: Joint Operational Warfare, Theory and Practice, 2009, 703.

² U.S. Department of the Navy and U.S. Department of the Coast Guard: A Cooperative Strategy for 21st Century Seapower, October 2007, 4.

³ U.S. Department of the Navy and U.S. Department of the Coast Guard: A Cooperative Strategy for 21st Century Seapower, October 2007, 4.

⁴ U.S. Department of Defense: The National Military Strategy of the United States of America, 8 February 2011, 18.

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